REMARKS

This amendment is responsive to the Office Action of June 9, 2008. Reconsideration and allowance of claims 1-10, 12-19, 21-27, 30-40, 42-50, 52-58, 61-64, and 66-72 are requested.

The Office Action

Claims 1-10, 12-19, 21-27, 30-40, 42-50, 52-58, and 61-64 and 66-72 stand rejected under 35 U.S.C. § 112, second paragraph.

Claims 1-7, 9, 10, 12-19, 32-38, 40, 42-48, 66, 67, 69, and 70 stand rejected under 35 U.S.C. § 103 as being unpatentable over Taylor (US 5,950,629).

Claims 8 and 39 stand rejected under 35 U.S.C. § 103 as being unpatentable over Taylor in view of Sumanaweera (US 6,443,894).

Claims 21-27, 30, 31, 49, 50, 52-58, 61-64, 68, 71, and 72 stand rejected under 35 U.S.C. § 103 as being unpatentable over Taylor in view of Wodicka (US 5,445,144).

"Haptic Object" is a Well-Defined, Common Term in the Art

As set forth in MPEP § 2111.01, the ordinary and customary meaning of a term may be evidenced by a variety of sources, including the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence.

"Haptic Object" is Defined in the Claims

Claim 1, lines 8-9, sets forth a "haptic object defined by". That is, claim 1 and the other independent claims each define the term "haptic object" within the claim itself.

More specifically, the claims define haptic object as being at least one of: (1) a mapping between a pose of the tool and an output wrench of the haptic device, or (2) a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device. Thus, the claims themselves clearly define "haptic object".

"Haptic Device" is Defined in the Specification

A "haptic object" is defined as a **mapping** between **pose** (i.e., position and orientation) and **wrench** (i.e., force and/or torque). See paragraphs [0030] and [0031] of the present application. For example, the mapping is often a mathematical mapping that associates the position of a robot arm with predefined output wrench values (i.e., force feedback). Thus, when the robot arm is moved to position x, the system outputs the force feedback associated with position x. But, when the robot arm is moved to position y, the system outputs the force feedback associated with position y. This position dependent force feedback is transmitted through the robot arm and felt by the user during movement of the robot arm.

Extrinsic Evidence

Haptic researchers and inventors frequently use the terms "object" or "virtual object" to describe "haptic objects". While much work focuses on applications where haptic objects are intended to simulate interactions with corresponding real-world objects, others consider more abstract mathematical mappings, deformable objects, or non-geometric object properties to be haptic objects or components of haptic objects. Note the following examples:

First, the applicant directs the Examiner's attention to "*Development of a Haptic Virtual Environment*", *Acosta, et al., Computer-Based Medical Systems, Proceedings 12th IEEE Symposium, pages 35-39, 1999*. Acosta uses "object" and "haptic virtual object" throughout this article. Section 3, for example, focuses specifically on the relationship between a graphical object and a haptic virtual object. Acosta distinguishes "haptic objects" which have interactive force properties such as stiffness and friction, and "virtual objects" which are strictly visual/graphical entities.

"Design of a Haptic Data Visualization System for People with Visual Impairments", Fritz, et al., IEEE Trans. on Rehabiliation Engineering, Vol. 7, No. 3, September 1999 defines an "object" by describing the associated "force profile" that is simply a mapping from position, velocity, and/or displacement information to a force output. See, for example, page 374, second column, which states:

> In order to determine the resulting force vector for an object, each object is given a force profile that determines how the object will "feel". Based on the position, the velocity, and/or displacement information discussed above, the force profile determines a constraint force, $\mathbf{F_c}$, which is typically normal to the surface, a friction force, $\mathbf{F_f}$, tangential to the surface, and a force due to surface texture, $\mathbf{F_t}$, if any. The resultant force, $\mathbf{F_{rslt}}$, is then the sum of these components as depicted in Fig. 4.

These "objects" are not necessarily simulations of real-world objects, but may be abstract entities such as points, lines, surfaces, and vector fields. See Section II, B-E.

"Simple Haptic Display and Object Data Design", Niki, et al., Proceedings of the 2000 IEEE/RSJ International Conference on Intelligent Robots and Systems, pages 967-972, 2000 discloses "objects" that have various haptic properties including stiffness, surface roughness, heat conduction, etc. Note Figure 3. Niki refers to a haptic object as a "virtual object". Note Figure 6, for example.

"A Constraint-Based God-object Method for Haptic Display", Zilles, et al., IEEE Proceedings, pages 146-151, 1995, also describes an object or an object model as a mathematical representation of a physical object containing its shape and other properties related to the way it feels. More specifically, the abstract states:

> A haptic display system has three main components. The first is the haptic interface, or display device – generally some type of electro-mechanical system able to exert controllable forces on the user with one or more degrees of freedom. The second is the object model – a mathematical representation of the object containing its shape and other properties related to the way it feels. The third component, the haptic rendering algorithm, joins the first two components to compute, in real time, the model-based forces to give the user the sensation of touching the simulated objects.

Thus, Zilles analogously defines a haptic object as a mapping between pose, (i.e., position and orientation) and wrench, (i.e., force and/or torque).

Copies of the above-discussed evidence of ordinary skill in the art and that the phrase "haptic object" is well-defined and commonly used in the art are enclosed.

See also, US Patent 6,084,587.

These publications are submitted as evidence of the level of ordinary skill in the art and the lexicography used win the art. These publications are not submitted as being material prior art. A PTO-1449 is enclosed for the Examiner's convenience, if the Examiner wants to make one or more of these publications of record.

The Claims Comply With the Requirements of 35 U.S.C. § 112

First, claim 1 calls for a haptic object "defined by at least one of: a mapping between a pose of the tool and a output wrench of a haptic device, and a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device". It is submitted that this definition of "haptic device" set forth in the claim itself particularly points out and distinctly claims the concept behind a haptic object.

In response to the Examiner's request to define the term and concept behind "haptic object", the applicant has proposed amending claim 2 to incorporate the definition of "pose" and the definition of "wrench" as set forth in paragraphs [0030] and [0031] of the specification.

The other independent claims similar to claim 1y set forth a definition of "haptic object" within themselves.

Second, the terms "haptic object", "pose", "wrench", etc. are well-known in the art as shown by the evidence submitted and discussed above.

Third, as pointed out in MPEP § 2111.01, the applicant can be his own lexicographer. The terms "haptic object", "pose", "wrench", and others are clearly defined in the specification. Note paragraphs [0030] and [0031] in particular.

Because "haptic object", "object", "pose", "wrench", and other terms used in the claims are well-known in the art and are defined in the specification or the claims themselves, it is submitted that all claims comply with the requirements of 35 U.S.C. § 112, second paragraph.

The Claims Distinguish Patentably Over the References of Record

Claim 1 calls for a haptic object defined by a mapping between a pose of the tool and an output wrench of the haptic object or a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device. Taylor fails to disclose or fairly suggest a haptic object as defined in claim 1. Taylor, by contrast, relates to an image-guided surgery system in which surgical instruments are monitored during a surgical procedure and their locations are displayed or superimposed on a diagnostic image. The system includes passive manipulation aids (column 13, line 46) to provide real-time advice to the surgeon based on the sensed relationship between a surgical plan and a surgical execution (column 13, lines 49-52). The system enhances what the surgeon sees, such as by visibly displaying the path of a surgical instrument on a displayed diagnostic image. This enables the surgeon to plan a trajectory for the surgical instrument and plot it on the image. By monitoring the position of the tools, such as with a video camera, the tool can be superimposed on the same diagnostic image such that the surgeon can see if the tool is following the planned trajectory. Because the surgeon may not want to observe the video display continuously, "advice" is provided in other ways as well as visual. For example, an audible signal can be generated when the instrument deviates from the path (column 20, lines 49-50). As another example, the system can provide resistance or braking force to indicate that the surgical tool is deviating from the planned trajectory (column 21, lines 13-15) or can even lock the tool from moving off the trajectory (column 14, lines 21-25). Unlike the present invention, these resistance or braking forces cannot generate forces as described in Claim 1. The resistance or braking forces are only generated based on the user's motion, i.e., when the user pushes against the brake.

Thus, Taylor is concerned with visualizing the position of a surgical tool in the interior of a patient where it is not readily observable by displaying the tool or a representation of a tool on a diagnostic image and which gives the surgeon "advice" if the tool is moved other than along a planned trajectory.

Accordingly, it is submitted that Taylor neither discloses nor otherwise puts the reader in possession of the concept of using a haptic object which is defined

by at least one of mapping between a pose of the tool and an output wrench of the haptic device or a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device. Accordingly, it is submitted that **claim 1 and claims 10, 12, and 16-20 dependent therefrom** distinguish patentably and unobviously over Taylor.

Claim 2 again calls for a haptic object defined by at least one of a mapping between a pose of a surgical tool and an output wrench of the haptic device, and a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device. Further, claim 1 states that "pose" connotes "position, orientation, velocity, and/or acceleration" and that "wrench" connotes "forces and/or torques".

Taylor provides no suggestion of any mapping between the pose (position, orientation, velocity, or acceleration) of a surgical tool and an output wrench (force or torque) of the haptic device. Nor does Taylor suggest mapping between a wrench (force and/or torque) applied by the user to the haptic device and an output position of the haptic device. Thus, Taylor does not suggest or provide any motivation to map between pose and wrench. Accordingly, it is submitted that **claim 2 and claims 3-9, 13, and 14 dependent therefrom** distinguish patentably and unobviously over Taylor.

Claim 21 again calls for a haptic object defined by a mapping between pose and wrench or between wrench and position. As discussed above, Taylor fails to disclose or fairly suggest such a mapping. Wodicka, which discloses a device for acoustically guiding an endotracheal tube as inserted into a patient's body, does not cure this shortcoming of Taylor. To the contrary, Wodicka reinforces that the "advice" referenced in Taylor should be audible.

Accordingly, it is submitted that **claim 21 and claims 22-27, 30, and 31 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 32 again calls for a haptic object. As set forth above, the device disclosed in Taylor is not a haptic object as defined in claim 32. Accordingly, it is submitted that **claim 32 and claims 33-37, 39, 40, 42-50, and 64 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 38 again calls for a haptic object. For the reasons set forth above, it is submitted that Taylor fails to disclose or fairly suggest the use of a haptic object. Taylor makes no suggestion of a mapping between pose or position and wrench. Accordingly, it is submitted that **claim 38** distinguishes patentably and unobviously over the references of record.

Claim 52 again calls for a haptic object. As stated above, Taylor does not disclose a haptic object. Wodicka not only fails to cure the shortcomings of Taylor, but motivates the reader of Taylor to rely on audio advice rather than other potential forms of "advice" suggested in Taylor. Thus, Wodicka, when combined with Taylor, teaches away from a haptic object and the mapping between pose or position and wrench set forth in claim 52.

Accordingly, it is submitted that **claim 52 and claims 53-58 and 61-63 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 66 again calls for a haptic object. As set forth above, it is submitted that Taylor fails to disclose or fairly suggest the use of a haptic object, particularly a haptic object defined by mapping between pose or position and wrench. Accordingly, it is submitted that **claim 66 and claims 67-72 dependent therefrom** distinguish patentably and unobviously over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-10, 12-19, 21-27, 30-40, 42-50, 52-58, 61-64, and 66-72 are now in condition for allowance. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

FAY, SHARPE LLP

Thomas E. Kocovsky, Jr.
Reg. No. 28,383
1100 Superior Avenue
Seventh Floor
Cleveland, OH 44114-2579
(216) 861-5582

L:\HMM\DATA\2008\MAKO200027-3.US.AMN.DOC